



Safe and Effective Navy and Marine Corps Recruit Training Programs

Daniel W. Trone, M.A., Timothy L. Bockelman*, KT,
CSCS, CDR Kerry R. Thompson, Ph.D.#



Operational Readiness Research Program,
Naval Health Research Center, San Diego, CA

*Support Battalion Headquarters Company,
Marine Corps Recruit Depot, Parris Island, SC

#Physical Training Consultant,
Naval Training Center, Great Lakes, IL

The 5th Annual Army Force Health Protection Conference and 2nd Annual DoD Population Health & Health Promotion Conference

Baltimore, Maryland
August 2002

trone@nhrc.navy.
mil

www.nhrc.navy.mil

NHRC San
Diego

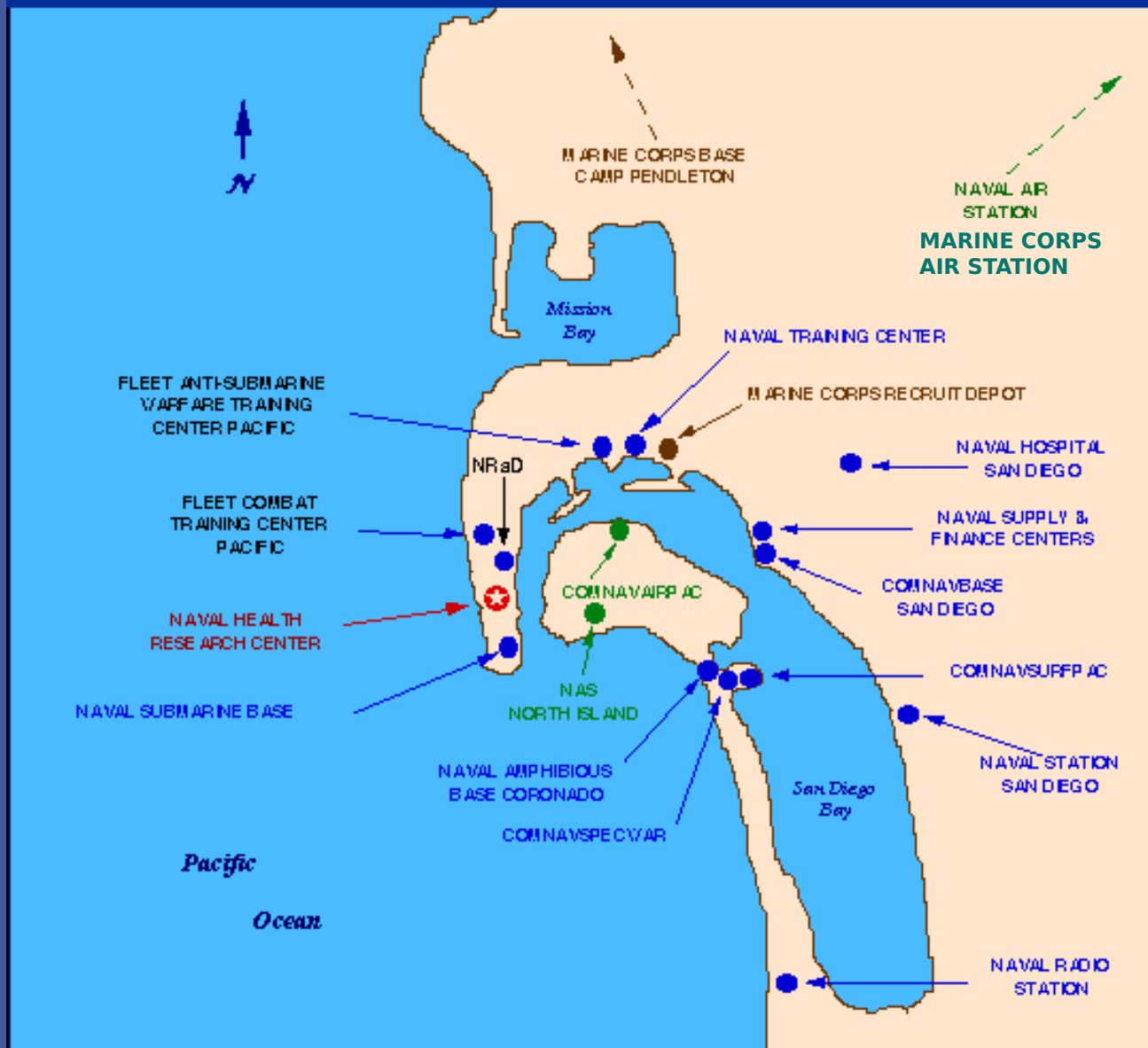


Presentation Outline

- **Overview of the Naval Health Research Center, San Diego, CA**
- **Code 24 Operational Readiness Research Program**
- **Targets for injury prevention**
- **Classic study applied to operational setting**
- **Study design - observational**
- **U.S. Navy - women, men?**
- **Marine Corps - men, women**
- **Current Research Efforts (new starts)**
- **Published injury research**



Major Naval Facilities in the San Diego Area



Naval Health Research Center

San Diego, CA



www.nhrc.navy.mil

**NHRC San
Diego**



THE BIG PICTURE

The laboratory's mission is to support fleet operational readiness through research, development, testing, and evaluation on the biomedical and psychological aspects of Navy and Marine Corps personnel health and performance.

ONR / BUMED
Washington, D.C.

Naval Health Research Center

Commanding Officer
Executive Officer
Administrative Officer
Command Chief

Technical Director

Research Support:
Library
Computer Support
Financial Operating Services

Health Sciences &
Epidemiology

Medical Information
Systems & Operations
Research

Human Performance

Personnel as of Oct
2001

170 persons

25 military: 17 officers

8 enlisted

57 civil service: 29 GS2 to
GS11

28 GS12 to

GS15

88 contractors

- Health Sciences
- Clinical Epidemiology
- Occupational Epidemiology and HIV Studies
- Emerging Illness

- Medical Information Systems
- Operations Research
- Psychophysiology and Performance

- Heat Stress
- Cold Stress
- WBGT monitors
- Body Composition
- Biomechanics
- Special Warfare

NHRC San
Diego



Sister Laboratories

- **Naval Submarine Medical Research Laboratory**
 - (NSMRL), Groton CT
- **Naval Aerospace Medical Research Laboratory**
 - (NAMRL), Pensacola, FL
- **Naval Health Research Center (Toxicology),
Detachment**
 - Dayton, OH
- **Naval Health Research Center (Electromagnetic
Radiation) Detachment**
 - San Antonio, TX



Operational Readiness Research Program

Head: CDR Richard Shaffer, Ph.D., MPH

- Determine illness and injury rates for samples or populations
- Identify important correlates (demographic, occupational, lifestyle, psychosocial)
- Develop and evaluate preventive strategies



Reducing injuries in training and operational populations



Improving lifestyle behaviors and reducing preventable diseases

NHRC San Diego



Musculoskeletal Injury Projects - Training Populations

- Determine rates of injuries
- Develop predictive profiles of injury susceptibility
- Develop and evaluate interventions to reduce injuries
- Surveillance





- Operational Populations

- Injury Study Subjects
 - Fleet Marine Force
 - Naval Aviators
- Study Objectives
 - Determine fitness and physical activity patterns related to MS injury
 - Determine risk factors for MS injury
 - Design preventive intervention



TRAINING



**NHRC San
Diego**



Targets for Injury Prevention

- Recruit (Pre-Training fitness level)

→ Training Schedules

→ Exercise Techniques



Physical Fitness

Health related Fitness

Cardiorespiratory
endurance

Body
Compositi
on

Musculoskeletal
fitness

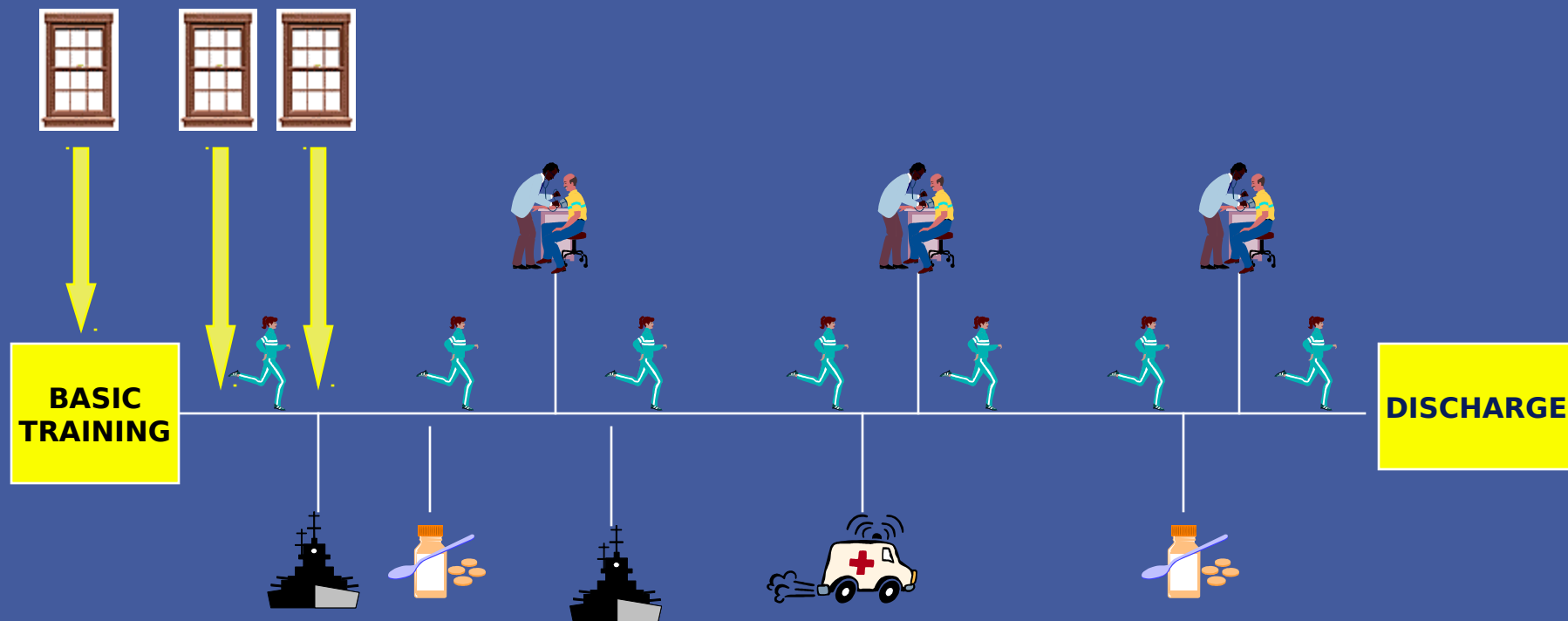
Strength
Endurance
Flexibility

Skill related Fitness

Agility,
speed,
power,
balance,
coordination
, reaction
time



The Accession Pathway and First-Term Enlistment







Effects of Training Duration on Incidence of Injury and V02 max*

min/day	% injuries	%V02 max (increase)
15	22%	8.6%
30	24%	16.1%
45	54%	16.9%

Training 3 days/wk, 85-90% HR Max

*Pollock, ML. Med Sci Sports. 9(1); pp31-36, 1977



RESEARCH STUDY DESIGN



Observational Studies (Study Design Taxonomy)



Past

Today

Future

Cross sectional
(Prevalence)

← Retrospective
(Case-Control)

Prospective →
(Longitudinal; Incidence)

→ Historical Prospective →



Goals of Study Design

- Eliminate/reduce bias
- Identify/control confounders
- Find associations
- Evaluate interventions



Potential Bias in Prospective Studies (systematic error)

- Outcome classification: Workable and concise criteria? Is the researcher blinded to exposure status? Are analysts blinded?
- Information bias: Are all independent variables collected the same for exposed and non-exposed? Is each subsequent exposure assessment consistent?



U.S. Navy Recruit Training Center Great Lakes, IL



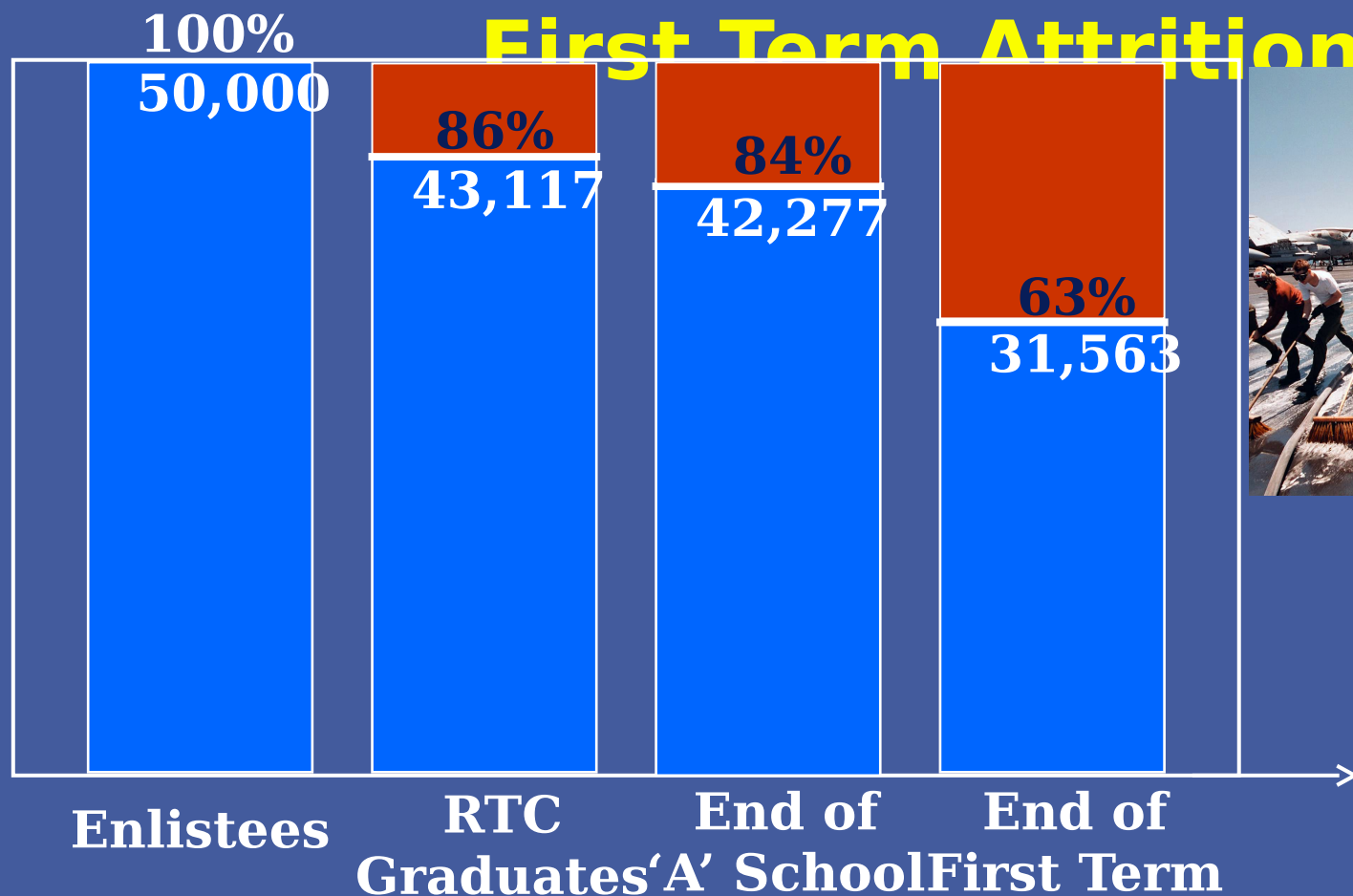
NHRC San
Diego



U.S. Navy Injury Prevention

Why important?

First Term Attrition





Development and Assessment of Training Models for the Prevention of Musculoskeletal Injuries in Navy Recruit Populations

CDR Richard A. Shaffer (Ph.D., MPH)

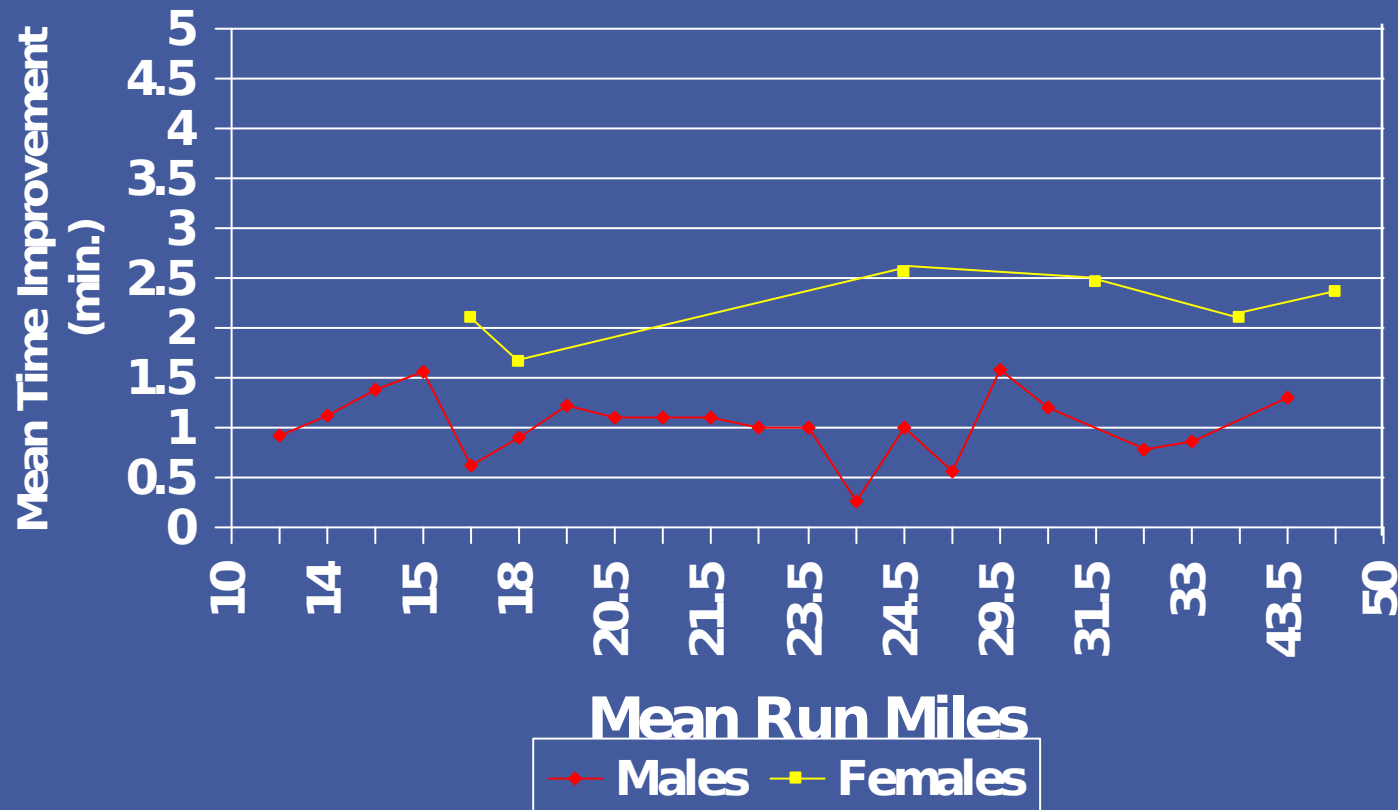
CAPT Stephanie K. Brodine (MD)(ret)

Rahn Y. Minagawa (Ph.D.); Stephen A. Tschinkel (MPH)

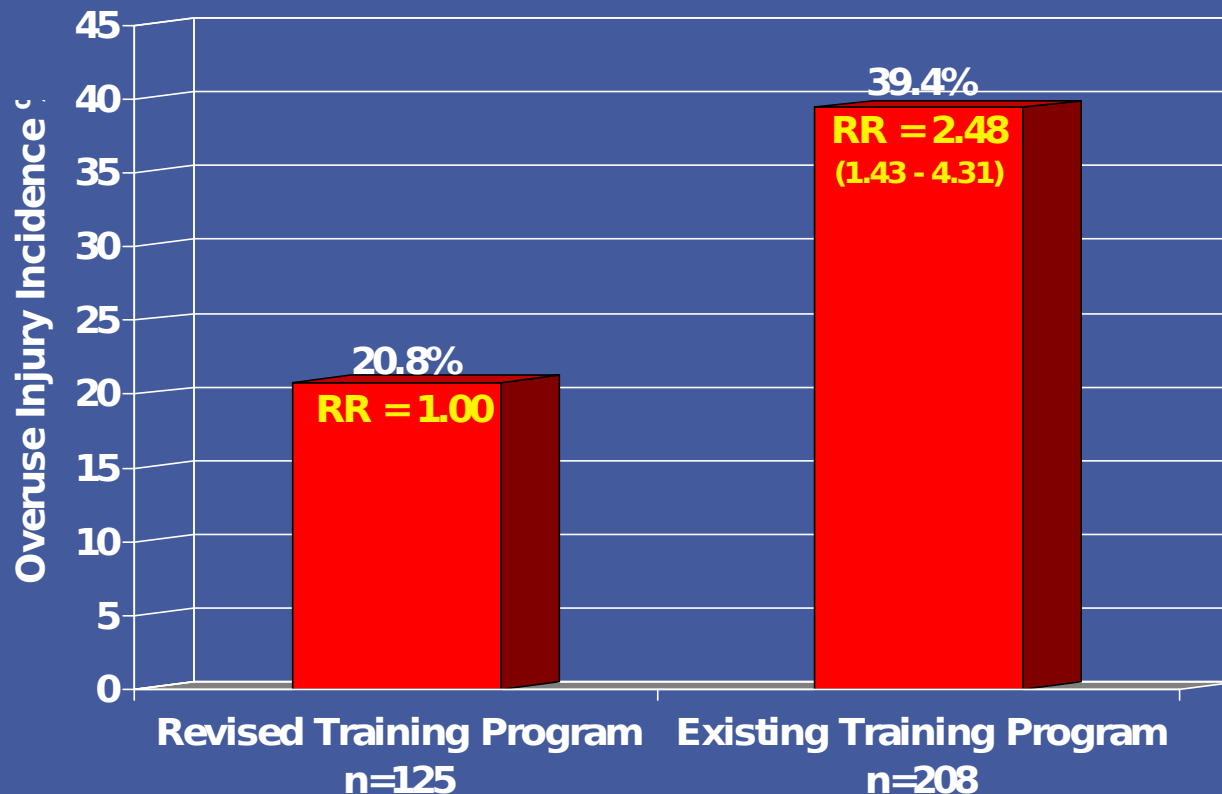
- Objectives / Goals :
 - Reduce MSI / STFX
 - Promote exercise and healthy habits long-term
- Methods :
 - Phase I – determine current MSI rates; objective and subjective
 - Phase II – quantify existing physical training (RDC logbooks); suggest revisions
 - Phase III – implementation using counterbalanced design
- Results : next two slides
- Conclusions



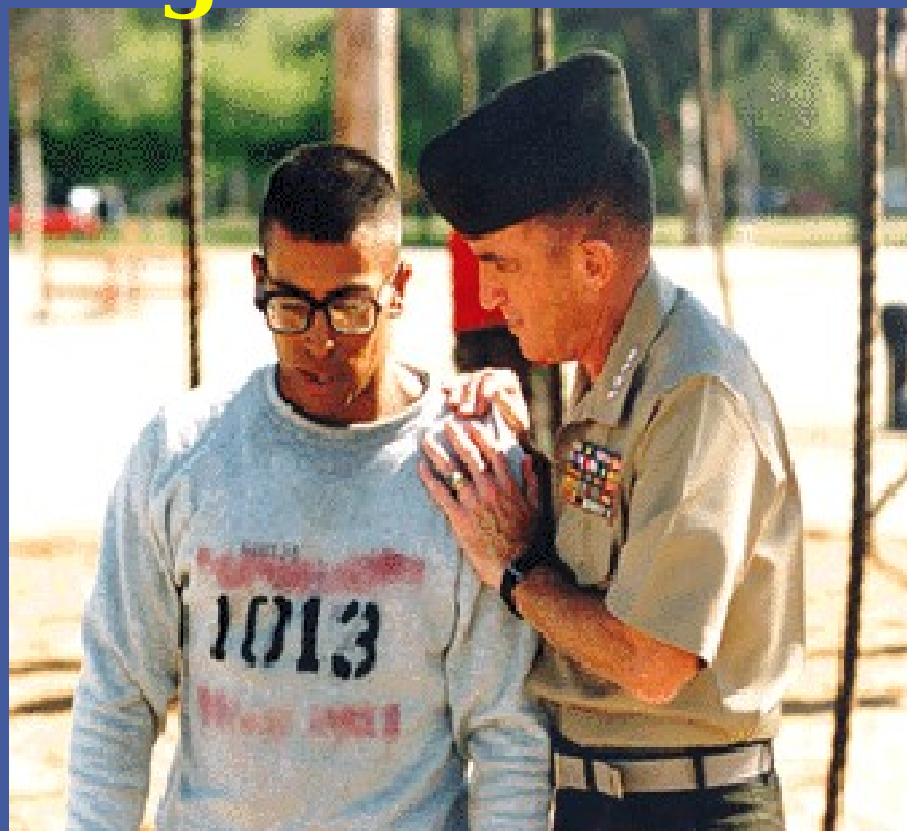
Run Time Improvement by Run Miles RTC Great Lakes



Overuse Injury Rates of Female Recruits Undergoing Revised versus Existing Physical Conditioning Protocol RTC Great Lakes



MCRD- San Diego



NHRC San
Diego



Impact of Injuries MCRD San Diego



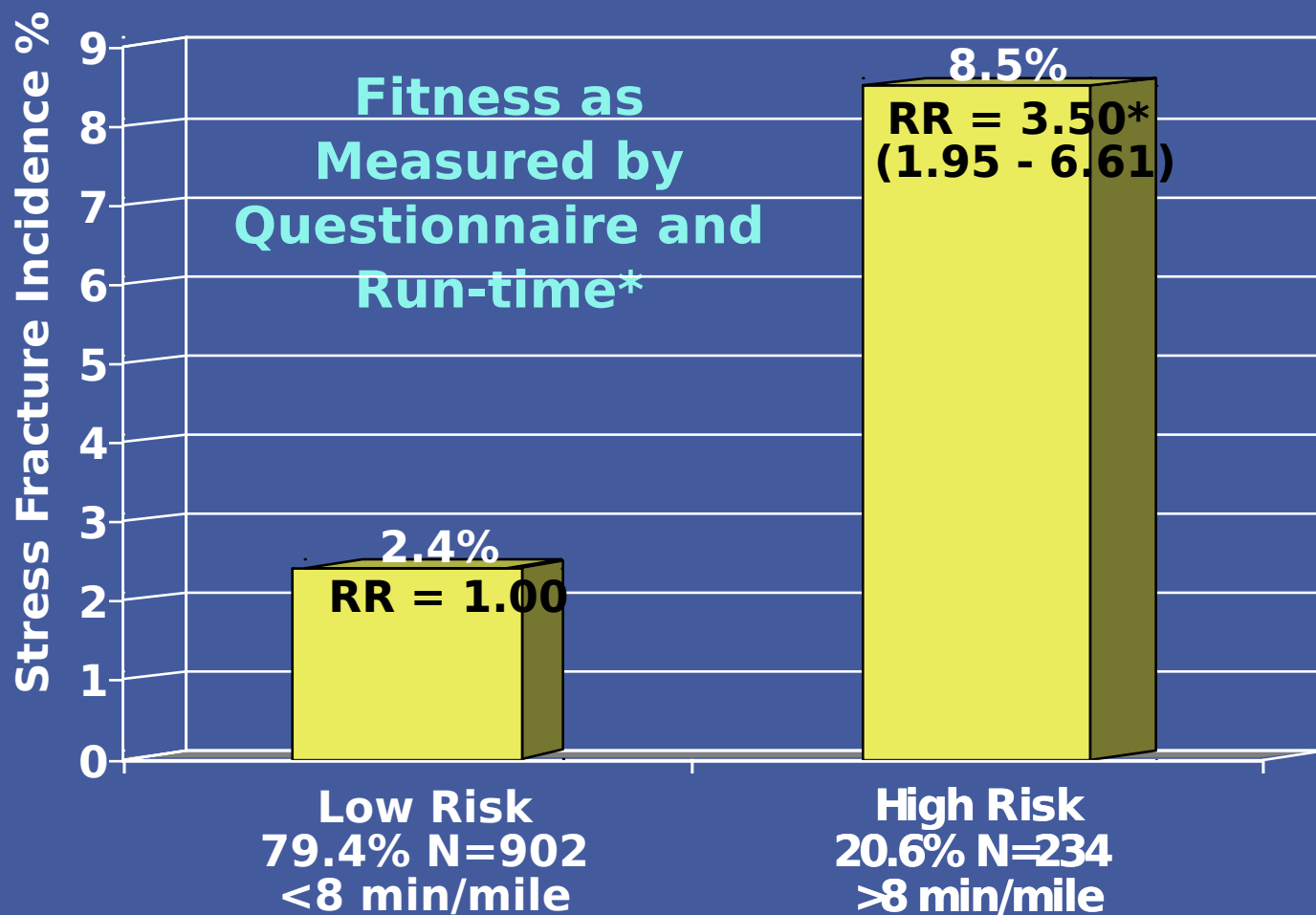
Fiscal
\$16.5 Million

Readiness
53,600 lost training days

**NHRC San
Diego**

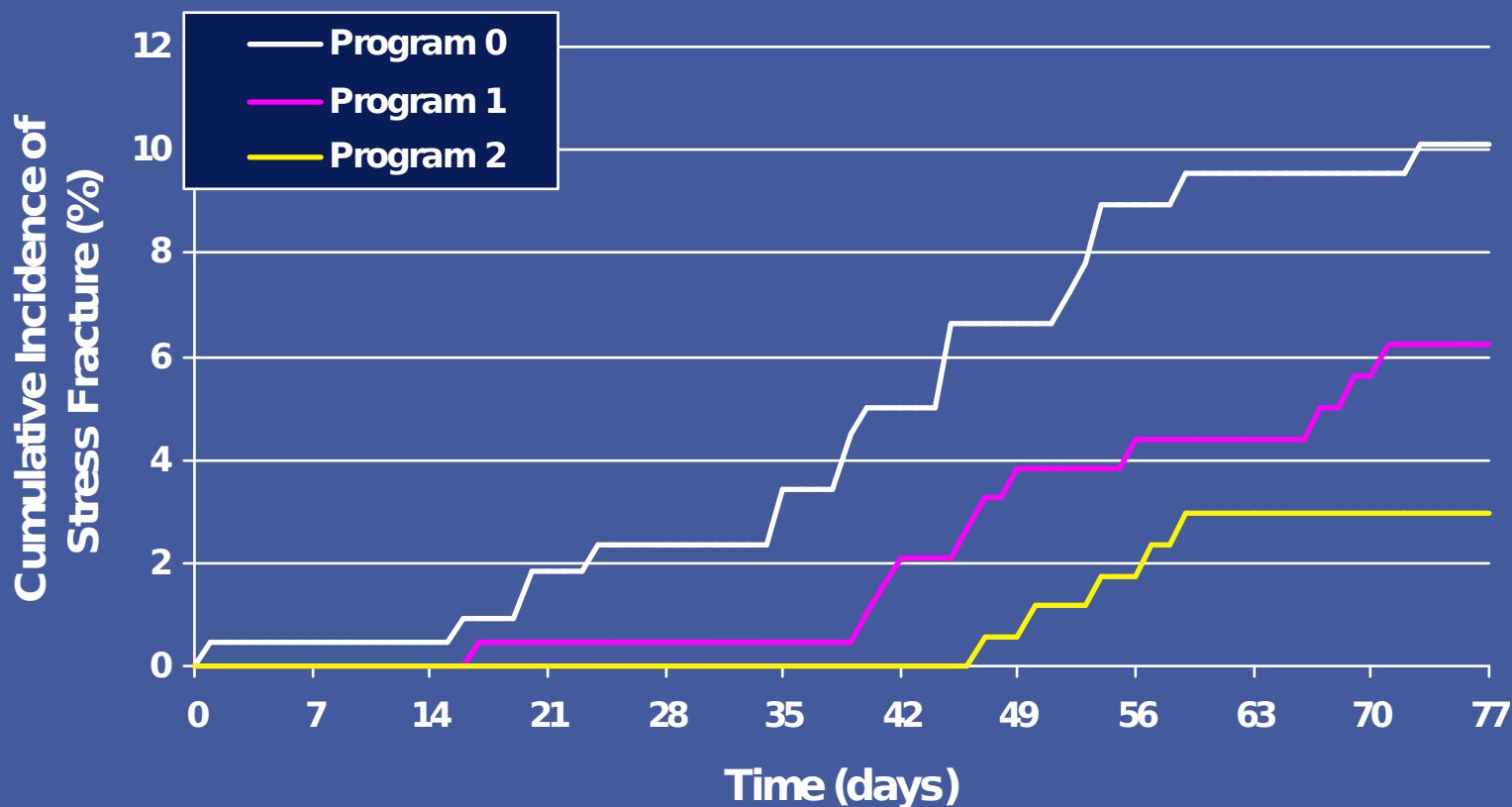


Results from Predictive Model for Stress Fracture Male USMC Recruits





Cumulative Incidence of Stress Fracture Among High Risk Recruits in Each Training Program During Recruit Training



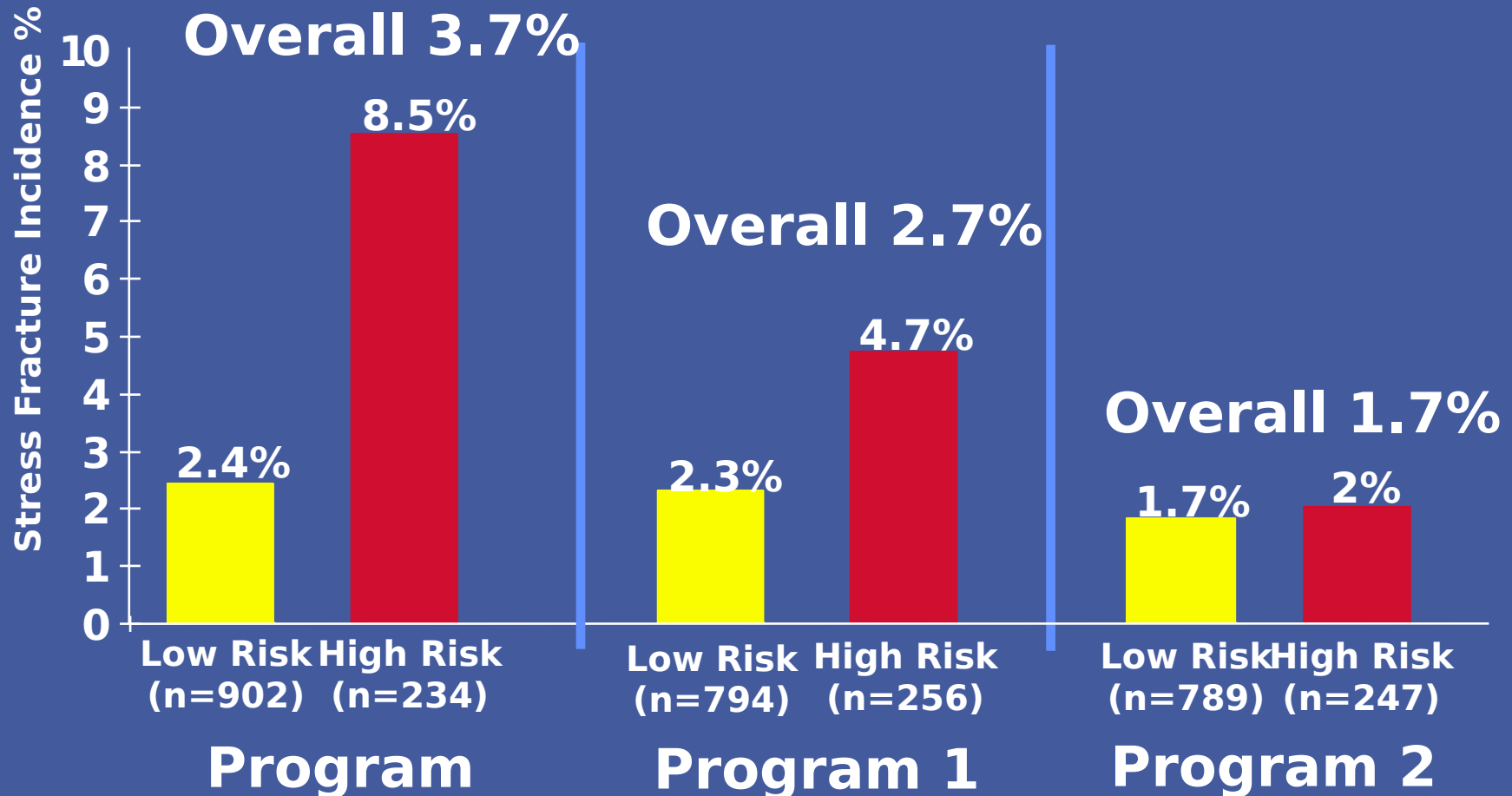
Initial Number of High Risk Recruits: Program 0 = 234; Program 1 = 256; Program 2 = 247

*Curves adjusted for the changing number of persons at risk over time.

**NHRC San
Diego**



Stress Fracture Incidence by Injury Susceptibility Groups



Shaffer, R.A. et al. Musculoskeletal Injury Project. In 43rd Annual Meeting of the American College of Sports Medicine. Cincinnati, OH, 1996. Invited speaker; abstract not available. **NHRC San Diego**



Final PFT Results

Program 1 Program 2

Score (mean)	263.70	262.20
Run Time (mean)	20:44	20:53
Pull-Ups (mean)	18.97	18.89
Sit-Ups (mean)	79.32	80.99



Morbidity and Cost Savings

A 50% reduction in **stress fractures**

- 370 less stress fractures per year
- Prevent 14,800 lost training days
- Cost savings of \$4.5 million per year



MCRD- Parris Island



NHRC San
Diego



Evaluation of a Modified Physical Conditioning Program for Female Marine Corps Recruit Training



Daniel W. Trone, M.A., Timothy L. Bockelman, KT, CSCS#, Scott Flinn*, CDR, MC, USN, Kelli A. Betsinger*, B.A., Heidi Kraft, LT, MSC, USNR, David H. Ryman, B.S., & Richard A. Shaffer, CDR, MSC, USN



Operational Readiness Research Program, Naval Health Research Center, San Diego, CA

***Branch Medical Clinic, Marine Corps Recruit Depot, Parris Island, SC**

Physical Fitness Advisor, Support Battalion Headquarters Company, MCRD-PI, SC

www.nhrc.navy.mil

NHRC San Diego



Physical Fitness Test Run Times

Group p-value	Run Time Mean (SD), Range	
IST 1.5-mi Run		
All Recruits n = 813		
• 1 Old POI p=0.02	13:05 (1:22), 9:10 - 16:20	1 vs. 2
• 2 Revised POI	13:29 (1:17), 9:54 - 16:40	

PFT 3.0-mi Run

All Recruits n = 822

- 1 Old POI 27:50 (2:45), 19:20 - 33:08 1 vs. 2 p=0.001
- 2 Revised POI 26:43 (2:30), 20:00 - 32:14



Relative Risk

Injury category	Old POI vs. Revised POI	Relative Risk (p=value)	(95% CI)
• All Injuries	0.03	1.26	(1.01,1.56)
• Acute	0.26	1.24	(0.85,1.82)
• Overuse	0.09	1.27	(0.96,1.68)
• Stress fracture	0.08	2.22	(0.88,5.60)
• Pelvic/Femoral Stress fracture		0.52	1.59 (0.39,6.50)
• Hip sprain/strain	0.12	2.38	(0.77,7.40)
• Tend/Burs Knee/Lower Leg		0.08	1.82 (0.92,3.61)



Graduation Rate by POI

Series	Grad on schedule	Grad	Separated
Old POI	78.1%	85.2%	14.8%
Revised POI	78.7%	91.8%	8.2%
Total	78.4%	88.4%	11.6%



Cost Analyses - Crude

- Does not include:

- medical separation pay
- facilities fees
- direct nor indirect personnel costs

- Does include:

- 1999 salary and chow cost

E-1 < 4 mo. \$909.00/mo.
\$30.30/day

E-1 > 4 mo. \$982.50/mo.
\$32.75/day

E-2 Graduates \$1,101.60/mo.
\$36.72/day



Other Cost Metrics

Series	Total PI Days	Recruit Salary and Chow
Old POI	12,145	\$471,040
111 per Grad	\$4,321 per Grad	
Revised POI	11,471	\$443,854
102 per Grad	\$3,963 per Grad	
Total	23,616	\$914,894
107 per Grad	\$4,140 per Grad	

“Savings” - women only

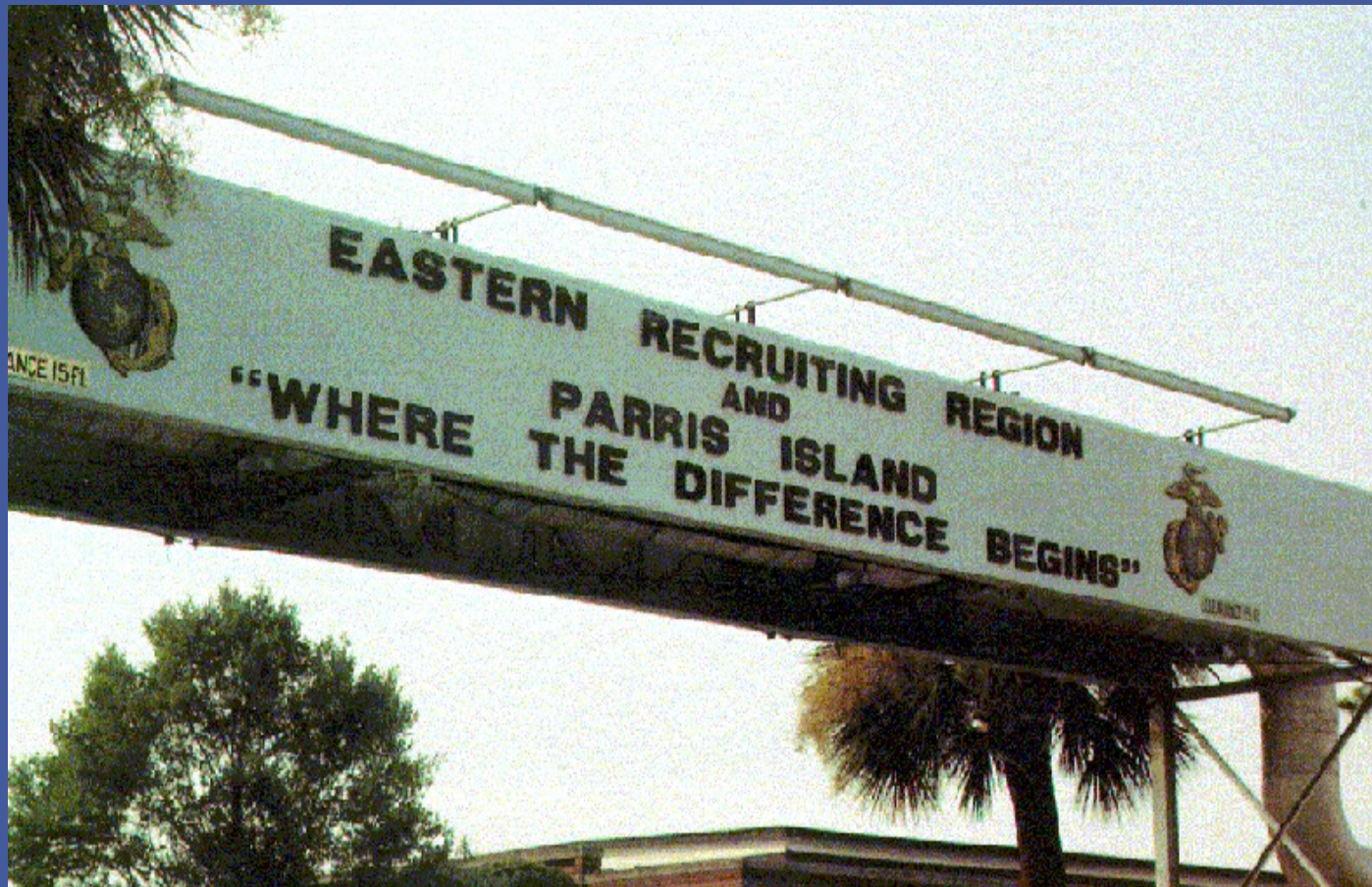
\$358 per Grad ~\$789,000 per year

9 PI days per Grad ~19,800 training
days per year



Conclusions

The physical training recommendations to the female Marine Corps recruits' program of instruction, made by the 4th Battalion Commanding Officer and the Support Battalion Physical Fitness Advisor, significantly reduced the number of stress fractures and the overall injury rate while maintaining high-intensity physical activity.



**NHRC San
Diego**

Current Research Efforts (New Start)



First-Term Outcomes Associated with Lower Extremity Injury in Female Marine Corps Recruits: A Historical Prospective Study

- **Bone BAA: Army Reimbursable; USAMRMC (Oct 2001 to Sept 2003)**
- **Background: MCRD-San Diego (men) STFX and graduated. First-term outcomes.**
 - N = 1,131 STFX n = 56 of which 39 graduated
 - 2.14 times discharge any reason
 - 6.12 times discharge physical disability
- **Proposed: MCRD-Parris Island (women)**
 - N = 2,962 STFX n = 152 of which 97 graduated
 - Causal relationship not assumed
 - May suggest STFX or severe MSI are associated with first-term discharge

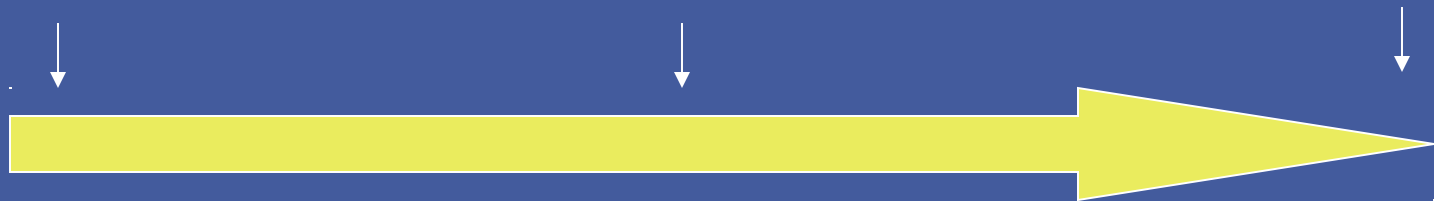


Historical Prospective Study (Non-concurrent Cohort Study)

Establish
exposure

Begin study
(now)

End of follow
up period

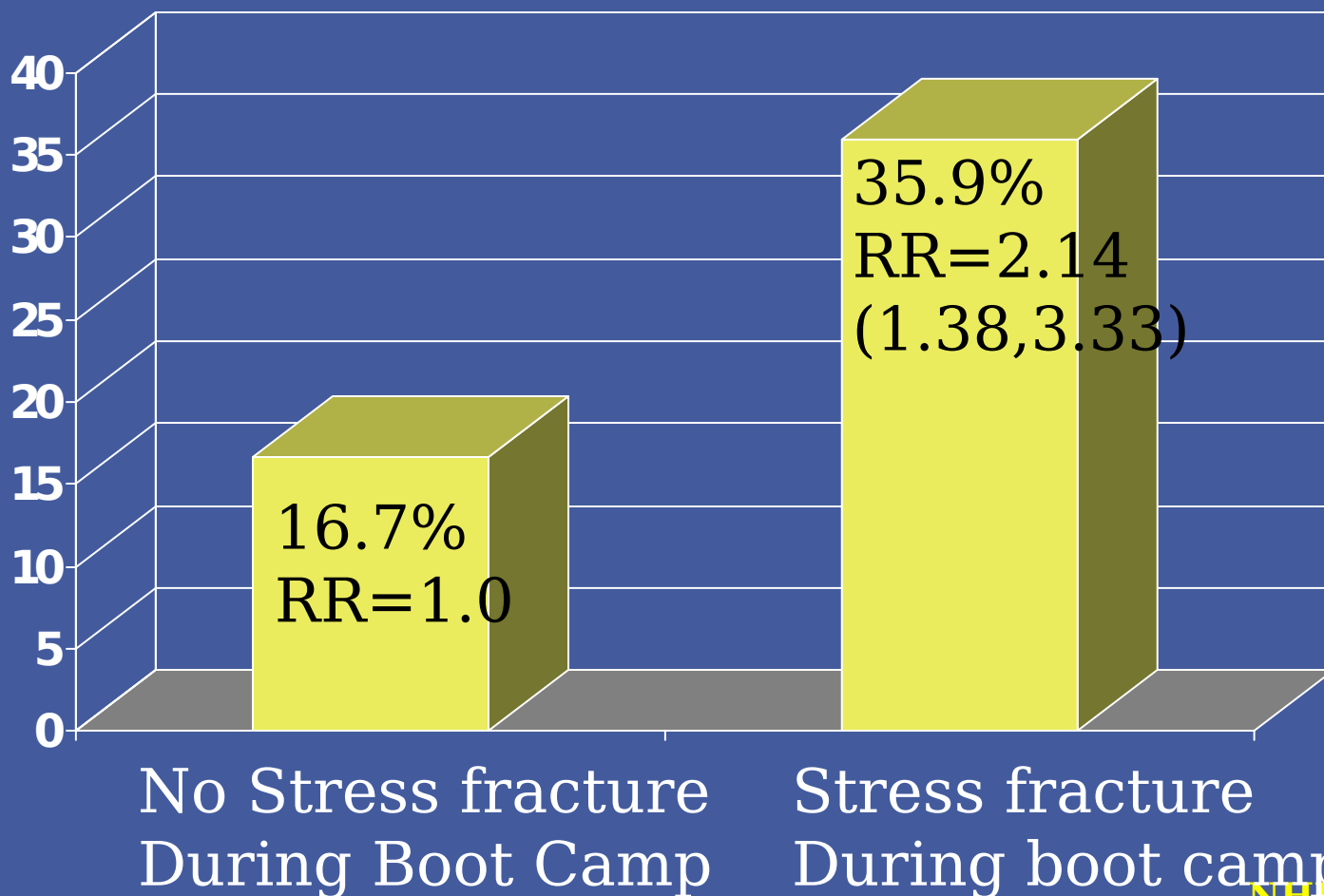


← Total follow up period →



Long term Outcomes Associated with Injury during Recruit Training, USMC Male Recruits

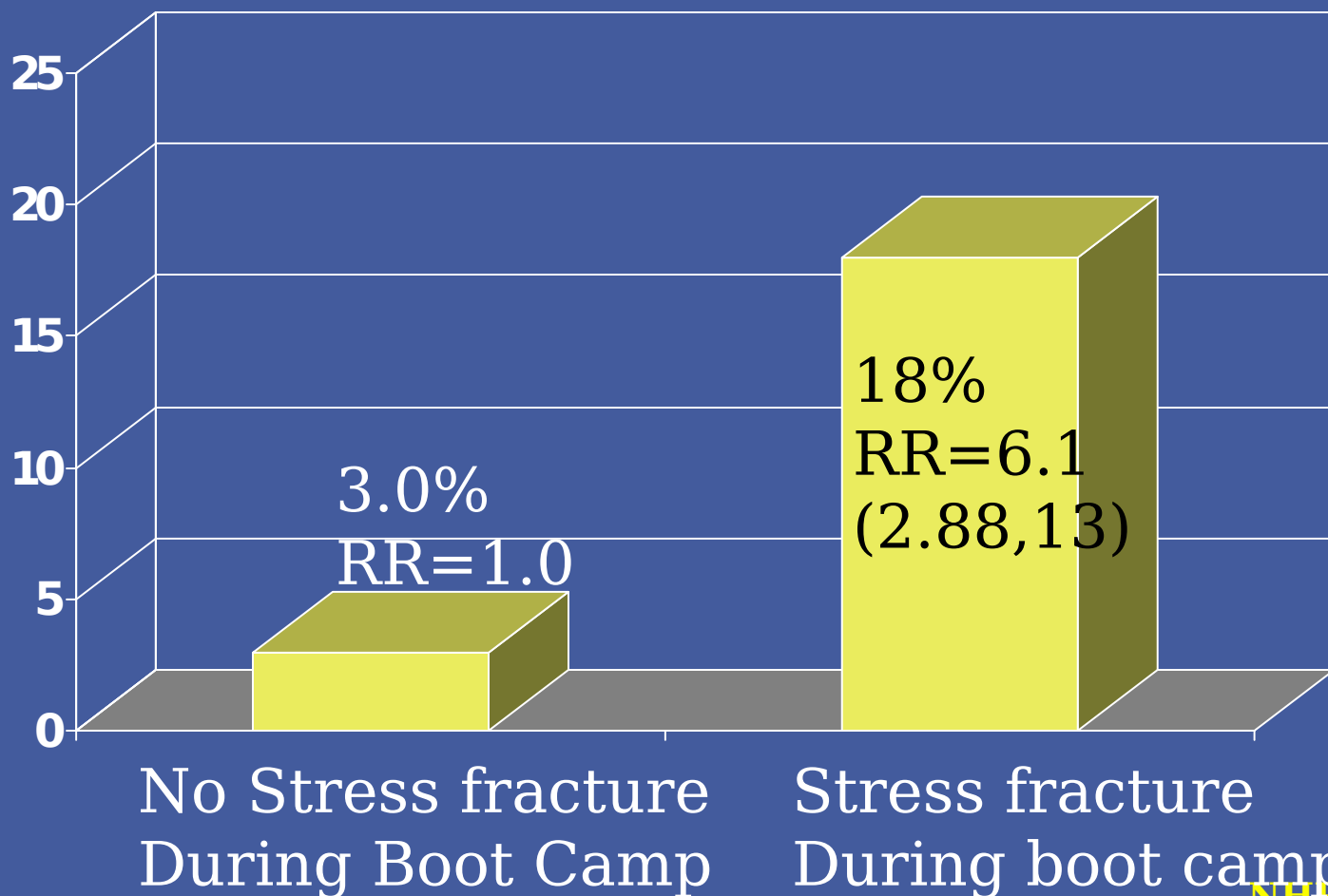
Discharged prior to term





Long term Outcomes Associated with Injury during Recruit Training, USMC Male Recruits

Physical Disability Discharge prior to term





STATEMENT OF WORK

● First Year:

- Peruse CHAMPS (The Career History Archival Medical and Personnel System)
- Determine first-term enlistment disposition
- Additionally, three measures of success will be examined:
 - completion of the first-term enlistment
 - completion of the first-term enlistment rank of Lance Corporal or Corporal
 - retention beyond the first-term enlistment
- Discharged: any reason or due to physical disability

● Second Year:

- Evaluation for hospitalizations and attrition
- Divide into MSI and STFX groups
- Report: estimated financial, manpower, and Fleet readiness impact

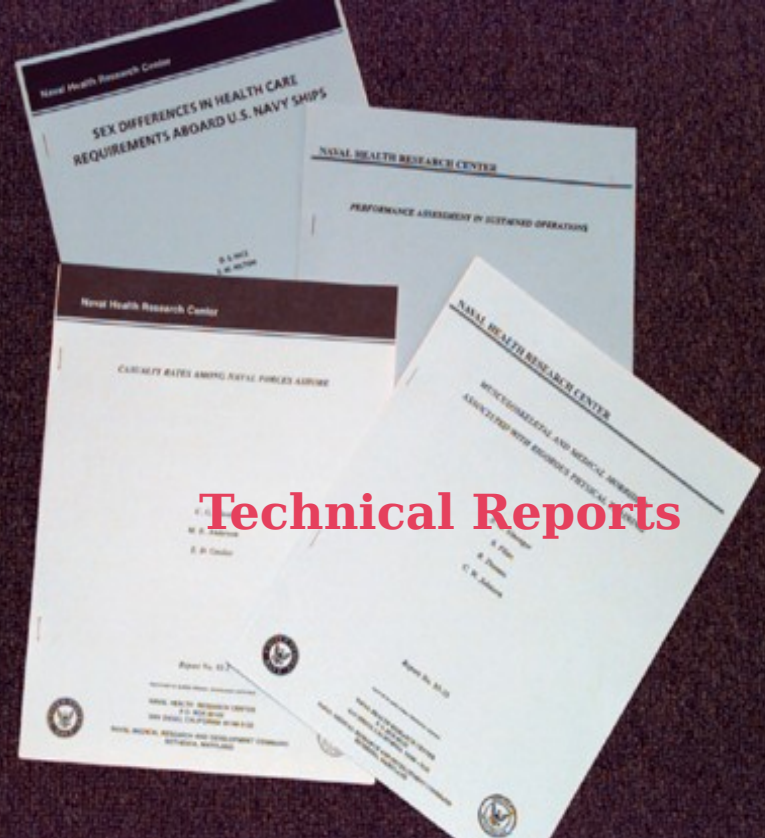


Current Research Efforts (New Starts)

- **Basic Underwater Demolition / SEAL trainees (BUD/S)**
- **MCRD - San Diego**
- **MCRD - Parris Island**



Published Research



Technical Reports



Journal Publications



Military Briefings

NHRC Operational Readiness Research Program



Published Injury Research

Running mileage, movement mileage, and fitness in male U.S. Navy recruits. Med Sci Sports Exerc 2001; 33:1033-1038.

Stress fracture in military recruits: gender differences in muscle and bone susceptibility factors. Bone 2000; 27:437-444

Military Training Related Injuries: Surveillance, Research, and Prevention. Am J Prev Med 2000; 18:54-63.

The association of blisters with musculoskeletal injuries in male Marine recruits. J Am Podiatr Med Assoc 2000; 90:194-198.

Gender differences in musculoskeletal injury rates: a function of symptom reporting? Med Sci Sports Exerc 1999; 31:1807-1812.

The effect of foot structure and range of motion on musculoskeletal overuse injuries. Am J Sports Med 1999; 27:505-508.

Use of simple measures of physical activity to predict stress fractures in young men undergoing a rigorous physical training program. Am J Epidemiology 1999; 149:236-242.

Epidemiological pattern of musculoskeletal injuries and physical training. Med Sci Sports Exerc 1999; 31:1176-1182.

Physical training program guidelines for U.S. Navy recruits: Preparing recruits for Battle Stations. NHRC TR No. 99-1A.

A physical training program to reduce musculoskeletal injuries in U.S. Marine Corps recruits. NHRC TR No. 97-2B 1997.

Biomechanical properties of infantry combat boot development. NHRC TR No. 97-26 1997.

Dual Energy X-Ray Absorptiometry Derived Structural Geometry for Stress Fracture Prediction in Male U.S. Marine Corps Recruits. J Bone Miner Res 1999; 14:1000-1008.

NHRC San Diego

Risk Factor Algorithm: Stress Fracture



STAGE 1

Algorithm for the assignment of subjects to a high or low risk group for stress fracture based on a self-report questionnaire and a 1.5-mi (2.4 km) run. U.S. Marine Corps recruit training, San Diego, California.

-AJE, vol. 149 (3), Shaffer et al.

HIGH PHYSICAL ACTIVITY INDICATORS

- a. Sweat: Quite a lot/all the time during activity
- OR
- b. Very good/excellent self-reported fitness
- OR
- c. Have been running longer than the 3 previous months
- OR
- d. Have ever been injured and fully recovered

None of the above

At least one

STAGE 2

LOW PHYSICAL ACTIVITY INDICATORS

- a. Sweat: Only occasionally
- OR
- b. Poor or fair self-reported fitness
- OR
- c. Weekly exercise frequency $\leq 2x$

At least one

None of the above

PHYSICAL FITNESS INDICATOR
1.5 Mile run time

Faster than 12:00 mins

Slower or equal to 12:00 mins

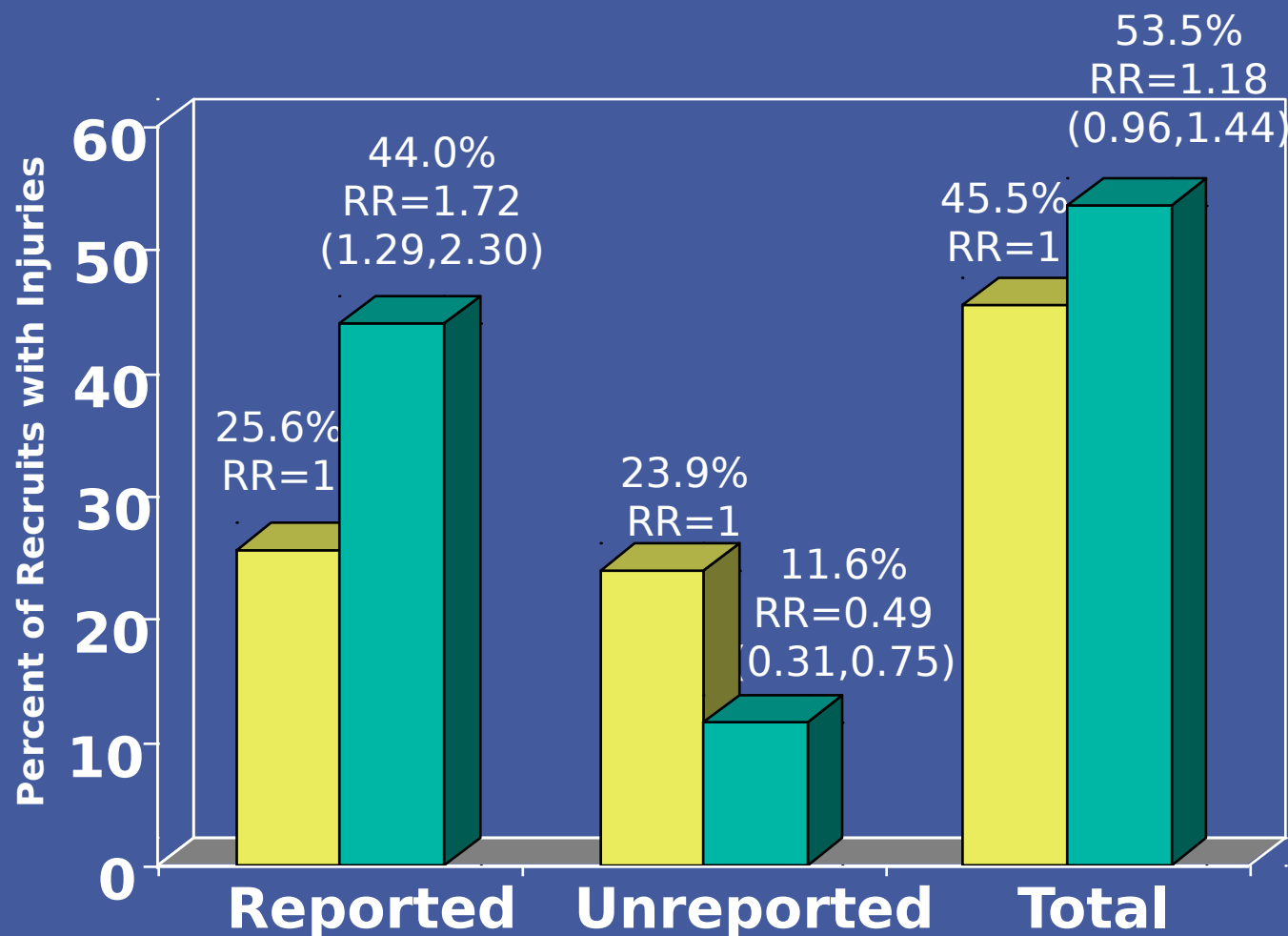
High Risk

Low Risk

NHRC San Diego



Gender Differences in Injury Rates U.S. Marine Corps Recruits

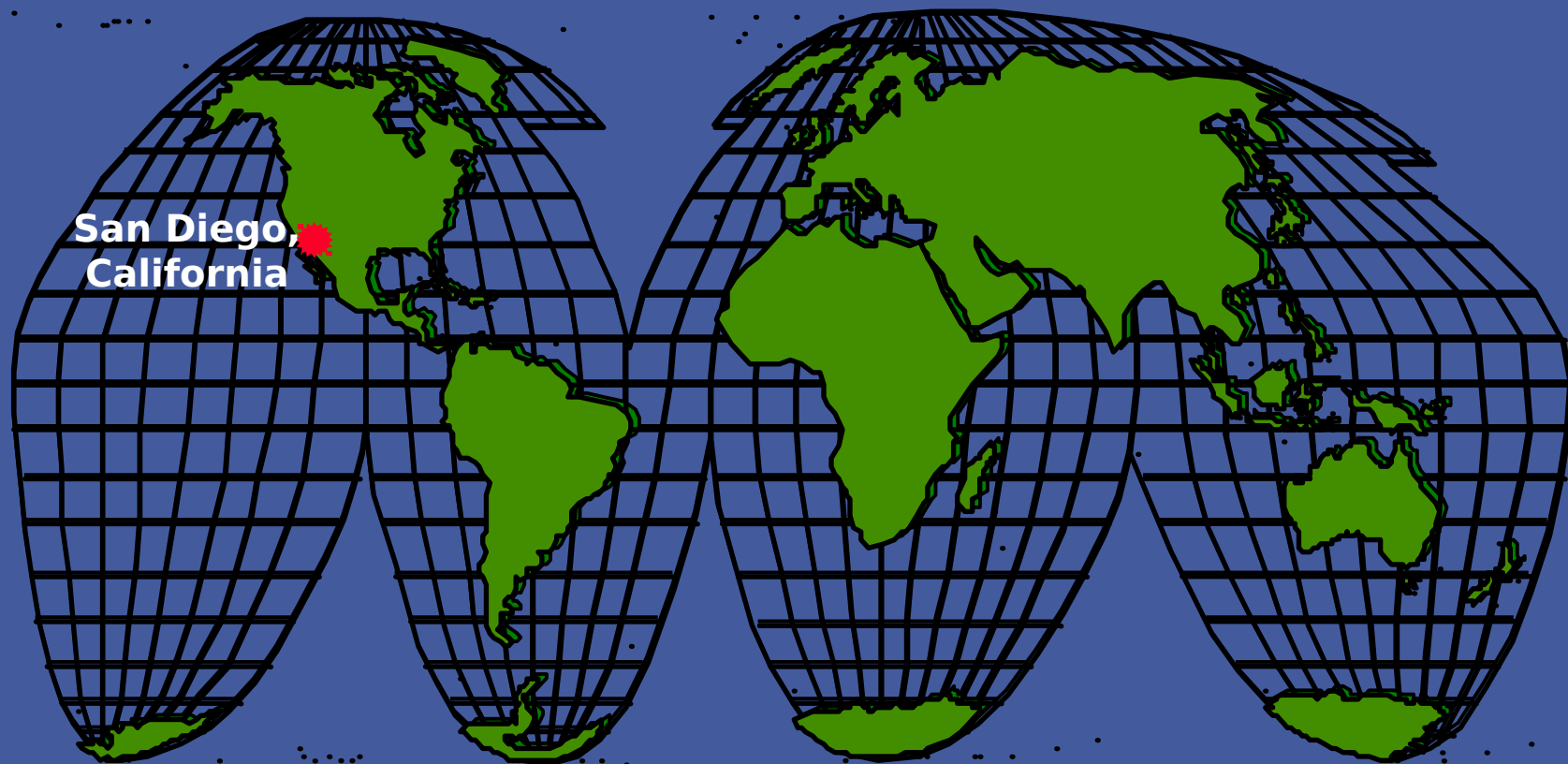


Male
Female

Gender differences in musculoskeletal injury rates: a function of symptom reporting? *Med Sci Sports Exerc* 1999; 31:1807-1812. Almeida, Trone, et al.



Naval Health Research Center



trone@nhrc.navy.
mil

www.nhrc.navy.m
il

Visit our Web site
<http://www.nhrc.navy.mil>

NHRC San
Diego